SB761
U7I5
86-4

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

FOREST PEST MANAGEMENT

STATE & PRIVATE FORESTRY

INTERMOUNTAIN REGION

3420
Report No. 86-4
February 1986

OPERATIONAL USE OF SYSTEMIC INSECTICIDE IMPLANTS TO SUPPRESS WESTERN SPRUCE BUDWORM[1] IN DOUGLAS-FIR CONES IN IDAHO

by

R. W. Thier[2]

ABSTRACT

Douglas-fir trees were implanted with acephate in the spring of 1985 to protect cone crops from western spruce budworm. Treated trees produced significantly more seeds per cone than untreated trees and sustained less defoliation.

INTRODUCTION

If National Forest System reforestation objectives are to be met, stores of seed must be maintained; thus, quantities of seed must be collected during good seed years to fulfill seedling production needs during poor seed years. Good Douglas-fir seed crops occur every 3 to 11 years with 2 to 3 years between light crops (USDA 1979). When seed supplies are exhausted and insects reduce or destroy a developing cone crop, reforestation plans can be upset or costly repeated site preparation may be necessary.

Western spruce budworm, a widespread defoliator of western coniferous forests, has been shown to feed on Douglas-fir cones throughout their development (Dewey 1970). Chrisman et al. (1983) reported that Douglas-fir cone crops can be reduced by general tree defoliation and reproductive bud damage caused by western spruce budworm. They speculated that cone crop losses could range from 30 to 95 percent. When western spruce budworm populations are high and cone crops light, nearly all cones may be damaged or destroyed (Fellin and Dewey 1982).

---

[1] Choristoneura occidentalis (Freeman) (Lepidoptera: Tortricidae)

[2] Entomologist, USDA Forest Service, Intermountain Region, Forest Pest Management, Boise, Idaho

LIBRARY
APR 18 1986
ROCKY MOUNTAIN STATION

Chemical control of western spruce budworm is possible and practical where values permit. To protect cone crops, chemicals are most often applied as ground-based foliar sprays, but where cone-crop protection on remote individual trees is desirable, foliar sprays are impractical and other portable systems are necessary. One such system involves implantation of systemic insecticides.

One EPA registered implantation technique for controlling western spruce budworm involves using Acecap® [1] implants which are plastic cartridges containing a gelatin capsule of powdered acephate (Reardon 1984). The cartridges are implanted into holes drilled into the tree stem and thus minimize the loss of insecticide. The insecticide is released and distributed into the tree when tree sap dissolves the gelatin capsule.

In late 1983, personnel from the Mountain Home Ranger District, Boise National Forest, became concerned about the limited supply of Douglas-fir seed from high elevation (5,500 ft.) sources. They also recognized that western spruce budworm was damaging cones being produced. With the potential for a collectable cone crop, an implantation project was planned and executed. Here I report results of that project.

METHODS

Tree Selection and Treatment

In 1984, Mountain Home Ranger District personnel identified a native stand of Douglas-fir from which to collect cones. The 3 to 4 acre area is located on Cow Ridge northwest of Featherville, Idaho, at an elevation of approximately 5,500 feet.

On April 5, 1985, 18 suitable trees were identified for treatment, marked, measured at breast height, and chemically implanted. The implantation procedure followed that described on the Acecap® product label and described by Reardon (1984).

Seed Yield and Analysis

Between August 21 and 27, 1985, I collected at least 25 cones from each of ten treated trees and ten untreated check trees in the Cow Ridge vicinity. The remaining eight treated trees did not bear a collectable crop and were dropped from the project. All cones from untreated check trees and four of the treated trees were gathered using an extendable pole pruner. The remaining six treated trees were felled by a forest crew to gather the cones. Cones were not inspected for insect damage as they were gathered, but rather the first 25 cones which were picked were used in this analysis. Additional cones gathered from felled trees by the forest crew were processed at the Lucky Peak Forest Nursery in Boise, Idaho.

---

[1] The mention of commercial products does not constitute endorsement by the USDA to the exclusion of other products that may be suitable. See precautionary statement on the last page.

I placed the cones from each tree into individual paper bags and recorded: whether cones were from a treated or untreated tree, number of cones, a subjective tree defoliation estimate (none, light, moderate, heavy), date gathered, and tree diameter.

I brought the bags to the laboratory and allowed the cones to air dry and open for three to four weeks. When cones appeared to be well dried and open, bags with cones were shaken and the number of dislodged seeds counted. I used this seed count to compute the gross unadjusted number of seeds per cone. This method was used in other studies (Reardon et al. 1985, Reardon et al. 1984).

Approximately ten seeds from each of the ten treated trees and ten untreated check trees were x-rayed to determine the proportion of sound and unsound seeds. The proportion of sound seed was used to compute the net adjusted number of seeds per cone or sound seed count.

I computed basic statistics and applied a two-tailed, two sample t-test to test the null hypothesis that the mean number of seeds per treated cone equalled the mean number of seeds per untreated cone. This statistical test was applied both to the gross unadjusted numbers of seeds per cone and the net adjusted numbers of seeds per cone.

Cost Accounting

Costs including supplies, salaries, and travel were recorded. Costs such as project planning, cone collection and processing, and overhead were not considered.

RESULTS

Tree Selection and Treatment

Table 1 shows the tree diameters and number of Acecap^{R} implants used in each tree. The average tree diameter at breast height was 11.68 inches. A total of 203 implants were used with an average of 11.28 used for each tree.

Seed Yield and Analysis

Defoliation levels and seed yield are displayed in Table 2. Based on my subjective estimates of defoliation, treated trees sustained less defoliation than the untreated trees; most treated trees were lightly defoliated while untreated trees were moderately defoliated.

An average of 28.40 cones per tree was gathered from each of ten treated trees and an average of 29.60 cones per tree was gathered from each of ten untreated trees. These cones yielded an average of 31.11 seeds per cone from the treated trees and 18.51 seeds per cone from the untreated trees, a difference of 68%. These counts constitute the gross unadjusted seeds per cone in Table 2. In only three cases did the number of seeds per cone in the untreated trees approximate or exceed the lowest count (22.89 seeds/cone) among the treated trees.

X-ray evaluation revealed that 70.41% of the treated seeds and 86.87% of the untreated seeds were sound, undamaged, and properly developed. I used these values to calculate the net adjusted number of seeds per cone (Table 2). The treated trees had a net adjusted average of 21.90 seeds per cone and the untreated trees 16.08 seeds per cone, a difference of 36%.

When a t-test was applied to both the gross unadjusted numbers of seeds per cone and adjusted numbers of seeds per cone, a significant difference (alpha = 0.001) was found between treated and untreated categories. I rejected the null hypothesis and concluded that this implantation project significantly increased the numbers of seeds per cone.

Cost Accounting

Direct costs of the implantation process included--materials $168.49, salary $393.41, and travel $60.00.

Costs totalled $621.90 or $34.55 per each of 18 trees. The average treated tree contained 0.42 bushels of cones yielding 0.38 pounds of filled seed as collected by forest crews and processed at the Lucky Peak Nursery. Therefore the cost of implantation attributed to the final nursery-processed product was $82.26 per bushel of cones or $90.92 per pound of filled seed.

Table 1. Diameters and number of Acecap^{R} implants used to protect a Douglas-fir cone crop from western spruce budworm, Mountain Home Ranger District, 1985.

Tree Number	Tree Diameter (in)	Number of Acecap^{R} Implants
1	14.9	16
2	12.1	13
3	11.0	12
4	11.0	12
5	11.5	12
6	9.1	10
7	12.1	12
8	11.8	11
9	11.2	11
10	14.1	12
11	10.9	10
12	15.2	15
13	10.2	10
14	9.8	8
15	11.9	11
16	13.4	11
17	11.9	10
18	8.1	7

Table 2. Results of operational use of systemic insecticide implants to suppress western spruce budworm in Douglas-fir cones in Idaho, 1985

TREATED TREES

Tree Number[1]	Method of Cone Collection: felled tree	Method of Cone Collection: pole pruner	Defoliation Estimate	Number of Cones	Number of Seeds	Gross Unadjusted Seed/Cone	Net Adjusted Seed/Cone
5	X		none	25	897	35.88	25.26
6	X		light	25	773	30.92	21.77
8	X		none-light	25	579	23.16	16.31
12		X	light	28	641	22.89	16.12
14	X		none-light	25	801	32.04	22.56
2	X		none	25	868	34.72	24.45
3	X		none-light	25	852	34.08	24.00
7		X	light	35	1154	32.97	23.21
10		X	light	43	1152	26.79	18.86
9		X	none-light	28	1054	37.64	26.50
$\bar{X}$ (± S.D.)				28.40 (6.02)	877.10 (196.04)	31.11 (5.18)	21.90 (3.64)

UNTREATED TREES

Tree Number[1]	Method of Cone Collection: felled tree	Method of Cone Collection: pole pruner	Defoliation Estimate	Number of Cones	Number of Seeds	Gross Unadjusted Seed/Cone	Net Adjusted Seed/Cone
-		X	moderate	29	510	17.59	15.28
-		X	light	25	704	28.16	24.46
-		X	moderate-heavy	30	427	14.23	12.36
-		X	moderate	33	737	22.33	19.40
-		X	light	25	392	15.68	13.62
-		X	moderate	41	482	11.76	10.22
-		X	moderate	31	469	15.13	13.14
-		X	moderate	26	448	17.23	14.97
-		X	moderate	30	391	13.03	11.32
-		X	moderate	26	780	30.00	26.06
$\bar{X}$ (± S.D.)				29.60 (4.86)	534 (148.17)	18.51 (6.29)	16.08 (5.46)

[1] See Table 1

DISCUSSION

Tree Selection and Treatment

Entomologists familiar with chemical implants agree that the proper timing of implantation is very important (Reardon and Stipe pers. comm.). Indeed, when a similar project was conducted applying the implants in mid May, statistical analysis of data was impossible since complete defoliation prevented the development and subsequent collection of cones (Reardon et al. 1984). They speculated that implantation with Acecap® implants sufficiently early to insure that the chemical is in the foliage when western spruce budworm begins feeding is most desirable. This project supports this speculation since the early April implantation provided a significantly greater seed yield among treated trees.

Another question of timing remains. Can implantation in the autumn, after trees become dormant but before snows arrive, provide cone protection the following year? Implantation projects would be more efficient if unhindered by deep snows.

Seed Yield and Analysis

Seed yield appears to generally vary directly with the degree of defoliation. Although small sample numbers prevent effective analysis, it appears that as the subjective estimate of defoliation in Table 2 increases from "none" to "moderate-heavy" the gross unadjusted seed per cone is reduced. This supports the report of Chrisman et al. (1983).

Both the average gross unadjusted number of seeds per cone and the average net adjusted number of seeds per cone were significantly greater for treated than for untreated trees. The results agree with Reardon et al. (1985) who found that Acecap® implants not only reduced larval densities of western spruce budworm but also spruce coneworm (Dioryctria reniculelloides Mutuura and Monroe) which jointly caused most of the cone damage in their study.

The total number of cones available to harvest is probably affected by implantation. Although I did not attempt to measure this factor, Chrisman et al. (1983) noted that western spruce budworm can decrease Douglas-fir cone crops and Reardon et al. (1985) found that Acecap® implants reduce western spruce budworm larval densities. It follows that the number of Douglas-fir cones on a tree can be protected throughout their development by suppressing western spruce budworm via Acecap® implants.

I did not address the question of implantation effect on seed development. Although 70.41% of the treated seeds and 86.87% of the untreated seeds were sound, one cannot say if this difference was due to implantation.

Cost Accounting

Although implantation was rather expensive on this small scale project, one can speculate as to the worth of future projects. If quantities of seed are

to be guaranteed collectable from desirable seed-producing trees, the value of completed reforestation plans, site preparation, site-suited planting, and increased timber production can be protected.

The cost of seed is available from nursery managers; currently Douglas-fir seed is valued at $234.00 per pound (D. Dolata pers. comm.). In reality the value of seed varies by locale because of supply and demand. The value of seed may be priceless when there is none to be had. All these factors must be considered when contemplating a cone protection project.

ACKNOWLEDGMENTS

T. DeSpain and D. Cahill assisted in implantation. Cone collection was made possible with the help of J. Marshall, D. Hamrick, R. Bischof, W. Schumacher, C. Lesch, and S. Nye. D. Dolata, Lucky Peak Forest Nursery assistant, provided consultation and x-rayed the seed samples. M. Marsden reviewed my data analysis.

REFERENCES CITED

Chrisman, A.B.; Blake, G. M.; Shearer, R.C. Effect of western spruce budworm on Douglas-fir cone production in western Montana. Research paper INT-308. Ogden, UT: USDA Forest Service Intermountain Forest and Range Experiment Station; 1983. 7 p.

Dewey, J. E. Damage to Douglas-fir cones by Choristoneura occidentalis. Journal Economic Entomology. 63(6):1804-1806; 1970.

Fellin, D.G.; Dewey, J. E. Western spruce budworm. USDA Forest Service, Forest Insect and Disease Leaflet 53; 1982. 10p.

Reardon, R. C. How to protect individual trees from western spruce budworm by implants and injections. USDA Forest Service, Agriculture Handbook 625; 1984. 15p.

Reardon, R. C.; Barrett, L. T.; Koerber, T. W.; Stipe, L. E.; Dewey, J. E. Implantation and injection of systemics to suppress seed and cone insects in Douglas-fir in Montana. Canadian Entomologist 117:961-969; 1985.

Reardon, R. C.; Cahill, D. B.; Thier, R. W. Implantation and injection of systemic insecticides in Douglas-fir in Idaho to increase seed yield. Report 84-6. Ogden, UT: USDA, Forest Service, Forest Pest Management; 1984. 9p.

USDA, Forest Service. Seed handbook. Forest Service Handbook 2409.26f Amendment 5, Ogden, UT; 1979.

Pesticides used improperly can be injurious to human beings, animals, and plants. Follow the directions and heed all precautions on labels. Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides where there is danger of drift when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment, if specified on the label.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S Environmental Protection Agency, consult your local forest pathologist, county agriculture agent, or State extension specialist to be sure the intended use is still registered.